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CONCEPT ATTAINMENT, CONDITIONING AND PERSONALITY

by

FREDERICK BESSAI

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Concept Attainment, Conditioning and Personality, submitted by Frederick Bessai in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

This dissertation is based upon the postulate that cognitive functions are related to previous learning and to the personality traits of the individual. More specifically the major hypotheses were that concept attainment performance can be altered by operant verbal conditioning and that individuals possessing certain personality traits will condition more readily than those who possess dissimilar traits. The two major experimental hypotheses tested were: (1) In a concept attainment task of a high level of difficulty, individuals who are preconditioned aversively to attributes which are relevant to these concepts will perform at a lower level than similar individuals who have not been so conditioned. (2) Introverts will condition more readily than extraverts and will therefore show a lower performance than extraverts in a cognitive task where both groups have been conditioned to avoid relevant cues.

Using the Maudsley Personality Inventory and a concept attainment test, a sample of 80 subjects was drawn from first and second year students in Educational Psychology. 40 extraverts and 40 introverts were arranged into an experimental and control group such that they were matched on the dimensions of extraversion-introversion, sex and performance on the concept attainment test.

In the experiment, subjects in the experimental group were given a semantic differential to determine their responses to the color black. They were then given a colored form discrimination test in which they received negative reinforcement for their selections on the black items. The purpose of the latter was to condition subjects aversively to the color black in test items. Subjects were then given the Concept Attain-

ment Test in which black figures were relevant attributes on some of the items. Finally subjects filled out another copy of the semantic differential. Control groups received the same treatment except that the form discrimination test was omitted.

An analysis of variance of the concept attainment scores revealed a significant difference between the experimental and control groups. This was particularly significant on the subscores on the items where black was a relevant attribute. There were no significant differences between extraverts and introverts or between males and females. A comparison of the ratings for the concept black on the semantic differentials indicated that the greatest shift occurred for the experimental group on the evaluative scale, relative to the other scales and to the shifts of the control group. The hypotheses concerning cue affect and concept attainment were supported whereas the hypothesis concerning extraversion-introversion and conditionability was rejected. It was concluded that concept attainment performance can be altered by operant verbal preconditioning and that extraversion-introversion is not a relevant dimension to this form of conditioning.

The findings of the study are generally consistent with the cognitive theories of Bruner but provide no support for the relevant aspects of Eysenck's theory of personality.

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CHAPTER I

INTRODUCTION

The past few decades have brought many exciting developments in psychology. Theory and research in the major areas such as personality, learning, and cognition have expanded immensely. In addition, a number of new fields have arisen which hold great promise for the extension of knowledge in psychology. Many of these developments attest to the vast number and complexity of the variables which occur in psychology. This has emphasized the ever present need to examine methodological approaches and strategies both in theory building and in research.

A recent trend in methodological approaches has been the systematization of the use of intervening variables and hypothetical constructs. Although this is by no means new to scientific theory construction, the use of such concepts has proven to be very helpful in providing a framework for observed data and in lending direction to research. In brief, the use of intervening variables and hypothetical constructs has established a closer and more effective relationship between theory and research.

In any rapidly developing science, and also in psychology in so far as it is a science, the close relationship between theory and research is of prime importance. Theory usually provides direction to research and research on the other hand provides the foundation for theory. These roles are often reversed however; research frequently suggests theory, and theory in turn provides the foundation for research. Thus there is a mutual interaction as knowledge progresses.

This interchange in roles between theory and research is mediated by intervening variables and hypothetical contructs. Research can either suggest intervening variables and hypothetical constructs which are ultimately used in theory construction or it can investigate those which are already a part of some theory.

The research of this dissertation takes the latter as its point of departure. It is an attempt to relate a number of theoretical constructs in personality and cognition. These have been selected from different points of view and are examined within the context of verbal conditioning and the performance of cognitive tasks. It is hoped that the experimental hypotheses selected will clarify to some extent the relationship of these constructs and that the results of the experiment generally will cast some light upon their interactions in cognitive behavior.

CHAPTER II

THEORETICAL BACKGROUND

Fundamentally, the experimental work of this dissertation is based upon the personality theories of Eysenck and the perceptual and cognitive theories of Bruner. This chapter presents an overview of these theories as they relate to the experiment and outlines some of the principles of learning and conditioning which constitute an introduction to the problem. Since the aforementioned theories are themselves based largely upon earlier work and earlier theories, it is necessary to outline some of these as well.

I THE PERSONALITY THEORY OF EYSENCK

Pavlov (Anrep, 1927) had originally postulated 3 major dimensions of the nervous system. He spoke of the strength of the nervous processes, the equilibrium or balance between the processes and finally the mobility of these processes. Pavlov also postulated the existence of two basic functional neural processes; these were excitation and inhibition. The first he understood to be something that increased the power of conduction in the C.N.S. of the links which existed between the conditioned stimulus and the response. Thus Pavlov considered excitation to be a central function in conditioning. Inhibition was an opposing function whereby responsiveness decreased and the conditioned response gradually became extinct.

The personality theory of Eysenck finds its origin in the early work of Pavlov. Eysenck rejected psychoanalytic concepts as inadequate and speculative and made a strong plea for the formulation of a personality theory which is rooted in experimentally verifiable data. He stated that a scientific theory of personality requires more of a foundation than the clinical judgment of the theorist; it must be based upon principles which can be tested empirically and which lead to further experimental hypotheses.

Eysenck proposed a model of behavior in which personality theory forms a link between the physiological and social aspects of psychology. In his system there is a causal chain from the basic concepts of excitation and inhibition to conditioning, extraversion-introversion and finally to social organization and the formation of attitudes. Briefly stated, individual differences in excitation and inhibition are believed to be related to differences in conditioning and to the personality traits of extraversion and introversion. Social organization and attitude formation are in turn related to the latter.

Eysenck adopted the concepts of extraversion-introversion from the original formulation of Jung (1921) who spoke of extraverted and introverted tendencies regarding the libidinal energy of the individual. In the extravert, the energies are directed toward the outer world, toward things and toward society, whereas the introvert directs his energies inward toward inner mental states. Eysenck isolated these dimensions of personality by factor analysis and postulated further that these behavioral patterns are related to excitatory and inhibitory potentials, or more generally, to certain types of nervous systems.

Eysenck (1957a, p.114) expressed this formally in his Postulate of Individual Differences:

> Human beings differ with respect to the speed with which excitation and inhibition are produced, the strength of the excitation and inhibition produced, and the speed with which inhibition is dissipated. These differences are properties of the physical structures involved in making stimulus response connections.

He related these differences to personality in his topological postulate which states in part (loc. cit.):

> Individuals in whom excitatory potential is generated slowly and in whom excitatory potentials so generated are relatively weak, are thereby predisposed to develop extraverted patterns of behavior... Individuals in whom excitatory potentials so generated are strong, are thereby predisposed to develop introverted patterns of behavior . . .

This postulate also relates strong reactive inhibition to extraversion and weak reactive inhibition to introversion.

Although Eysenck found it necessary to define excitation and inhibition more distinctly to concur with present learning theory, the concepts are essentially similar to Pavlov's original formulations. Pavlov distinguished external and internal inhibition which Eysenck described as temporal and spatial inhibition. Eysenck's approach to learning and conditioning as well as inhibition is expressed in his Law of Temporal Inhibition (1957a, p.46):

> Whenever a stimulus-response connection is made in the central nervous system, both positive (excitatory, facilitative) and negative (inhibitory, obstructive) changes occur in the neural media responsible for the transmission of the impulse. The former type of change is responsible for conditioning and learning and makes easier the passage of the neural impulse linking stimulus and response; the latter type of change is responsible for unlearning and extinction and makes more difficult the passage of the neural impulse linking stimulus and response.

According to Eysenck's theory, extraversion and introversion then are more than behavioral tendencies; they are personality traits which are related to constitutional factors. The theory might then be profitably considered according to three levels. The basic level of excitation and inhibition, the experimental level of conditioning or learning and perception, and finally the behavioral level of personality traits leading to social behavior. Principles from the higher levels are derived from those of the lower levels. In accordance with Eysenck's criterion of a good theory, his basic hypothesis of an excitation-inhibition balance has led to a considerable body of experimental work in the areas of perception and learning. Eysenck and his co-workers studied excitation and inhibition through figural after-effects, rotation effects and perceptual fluctuation. Learning experiments were concerned with reminiscence, serial learning position effects and retroactive inhibition.

One important derivation of Eysenck's topological postulate is that since introverts generate excitatory potentials quickly and inhibitory potentials slowly and weakly in contrast to extraverts where the converse is true, introverts should condition much more easily than extraverts. Eysenck and his co-workers have produced experimental evidence to support this. Other psychologists however, following in the behavioristic tradition of Hull and Spence have produced experimental evidence to indicate that it is not extraversion-introversion which causes differences in conditionability but drive in the form of anxiety. The details of this controversy are summarized in Chapter III.

The prime importance of conditionability to Eysenck's theory lies in the fact that it forms the crucial link between the personality level of his behavioral model and the basic level of excitation and inhibition.

II THE COGNITIVE THEORY OF BRUNER

Bruner's theory of cognition, like some of the theories of earlier psychologists, is closely related to perceptual theory. Two of his earlier studies on perception (Bruner and Postman, 1947 and Bruner and Goodman, 1947) indicate some relationship to the cognitive theories of his later publications.

Bruner (1957a) adopted a molar approach to perception and cognition; he stated that all perception is generic in the sense that it is essentially a categorization process. The act of perceiving then involves a progression from clues to categorical identity. Whatever is perceived achieves its meaning from a class of percepts with which it is grouped. Accordingly, perceptual learning then involves the establishment of coding systems. These systems constitute the basic theoretical constructs of his theory. They are the means by which the individual structures perceptual events and makes predictions about them.

Bruner (1957a, pp.130-132) described the categorization process in terms of (1) preliminary and rough categorization; (2) a cue search during which there is maximum cognitive openess; (3) a confirmation check during which there is some closure in the identification process and (4) confirmation completion where the congruent cues are fitted

to a category and irrelevant ones are gated out or no longer considered. Briefly stated then, Bruner's position is that perception is a decision making process involving the identification and use of discriminatory cues which are ultimately fitted to categories. Much of the quality of perceptual and cognitive functioning then is a function of category accessibility.

Bruner (1957a, pp.134-137) further described some of the mediational processes which affect category accessibility, including grouping and integration, where perceptions are arranged in some order and integrated with former perceptions; access ordering or the degree of accessibility of categories which he considered to be related to the context of perception, and a match-mismatch process which specifies the extent to which certain stimuli fit a category and therefore end the cue search.

Perception, according to Bruner (1957a, p.138) also involves a gating process which filters the perceptual input. He proposed this as an explanation of why categorization sometimes fails, and suggested that the gating and filtering process might explain the phenomena of perceptual defense, perceptual vigilance, a number of forms of set, and the reduced veridicality of perception under stress. The cognitive counterpart of what is commonly called repression, where the individual does not perceive emotionally negative material, may be a function of the reduction of estimated probability of occurrence or it may be a narrowing of category width which reduces accessibility or perceptual readiness.

Bruner's general cognitive model of behavior can be extended to include some of the experimental findings on selective attention. The

fraction of the total stimuli to which the individual attends, to the exclusion of the rest, might then be described as those which are being matched to available categories. In a similar manner, those which are not being attended to can be described as being gated out.

Bruner's cognitive theory lends itself rather directly to a theory of concept formation and concept learning. The categorization process or perception is basic in behavior at the conceptual level. Bruner defines a concept as a category or a class of stimulus events which elicits a common response. Concepts then are essentially classes of information which are manipulated by the use of formal coding systems. Language is an eminent example of such a coding system. The construction of a formal model or a theoretical construct then is essentially the creation of an efficient coding system that permits reasoning which reaches beyond the data given. Bruner (1957b, p.64) describes this abstraction process as emptying the problem of its specific contents.

The formation of concepts then involves the invention of categories in response to events. The attainment of concepts involves the search for relevant attributes of some object or event by which it may be considered to fit or not to fit a given category. Experimentally the process involves the selection of an array of instances which have a number of attributes and values. A sequence of decisions follows where some of these are tentatively withheld and ultimately accepted as either correct, incorrect, or indeterminate. Bruner (1956, p.83) described the sequence of decisions in concept attainment as the strategy. Further research in the nature of concept formation has led to the identification of various kinds of strategies in concept attainment.

III CONCLUSION

The theoretical model of cognitive behavior as described by Bruner, and Eysenck's personality theory form the background for the experiment of this dissertation. According to Eysenck's theory of personality, the traits of extraversion and introversion are related to differences in neural capacities for excitation and inhibition; these differences in turn result in a difference in the extent to which individuals will condition. Individuals selected on the basis of the personality traits of extraversion and introversion will then show concomitant differences in conditionability. According to Bruner's cognitive theory, perceptual and cognitive behavior involves a categorization, decision-making function which is influenced among other things by a gating or filtering of the perceptual input. The latter aspect of Bruner's theory is derived in part from experimental work in perception where it was demonstrated that certain preliminary experiences, particularly preliminary conditioning of certain cues, results in the modification of subsequent perceptual and cognitive behavior which includes these cues.

The experiment is designed to relate Bruner's theory of perceptual and cognitive behavior to Eysenck's theory of personality through the common element of conditioning. Since extraverts and introverts differ in the ease and extent to which they condition, they should show differences in cognitive performance on tasks where conditioned cues are relevant. The cognitive tasks selected for the experimental procedure are drawn from the experimental work of Bruner and his associates and therefore are suited to the theoretical orientation outlined.

CHAPTER III

SUMMARY OF RELATED RESEARCH

Over the past two decades, the research in cognition and personality has been so extensive that it is difficult to select articles for inclusion in a summary of this kind. A summary of all the available literature in personality, verbal conditioning and cognitive functioning would be inappropriately cumbersome. Consequently only those studies which deal more or less directly with conditioning as related to extraversion-introversion, to concept attainment and perception are included. Even in these areas the review is not comprehensive; in some cases only a few studies are included which are believed to be representative of the research in their respective areas.

An interesting controversy arose in the literature over the personality variables related to conditioning; a number of hypotheses contrary to Eysenck's theoretical position were advanced and experimentally supported largely by American researchers. These are included under the section on conditioning and personality. In concept formation and concept attainment, only a few studies are included which investigated relevant personality and situational variables and those dealing with the preconditioning or alteration of cues.

Conditioning and Extraversion-Introversion

Franks (1956) investigated conditioning and its relationship to personality using 20 neurotic introverts, 20 neurotic extraverts and 20 normal subjects. Using eyeblink conditioning and sound as the conditioned stimulus, he found that in terms of both conditioning and ex-

tinction, the neurotic introverts conditioned most readily, and the neurotic extraverts conditioned least readily. The normal subjects ranged between the other groups and were not significantly different from either group.

In another experiment, Franks (1957) found a significant negative correlation (-.46) between conditioning and extraversion and no relationship between conditioning and neuroticism.

Vogel (1960) used G.S.R. conditioning and found that introverts conditioned much more readily than extraverts.

Spence (1958) advanced another theory of conditionability based upon the principles of Hull. Hull stated that excitatory potential was a multiplicative function of drive and habit strength. Spence equated Taylor's concept of manifest anxiety with Hull's concept of drive and thus hypothesized that conditioning was related to manifest anxiety. Spence and Farber (1953) and Spence (1958) report research to support this hypothesis. Recently Spence (1964) has published a review of some 25 studies dealing with conditioning and anxiety. Out of the 25 studies he reviewed, he found 21 to be in favor of his hypothesis.

Eysenck's reply (Eysenck 1957, Ch. IV) to the Spence-Taylor hypothesis was that the high anxious subjects were neurotic and introverted and conditioned because of introversion. He stated that the Taylor Manifest Anxiety Scale was a good measure of neuroticism, and that neuroticism tends to correlated with introversion.

Field and Brenglemann (1961) investigated the importance of drive and excitation-inhibition balance to eyelid conditioning. They found no relationship between eyelid conditioning and any of the following:

drive level, neuroticism, anxiety and extraversion-introversion. Their findings indicated that conditionability was related to rigidity.

Becker and Matheson (1961) investigated G.S.R. conditioning, anxiety and extraversion-introversion and found no evidence of a relationship between extraversion and conditioning and only suggestive evidence of a relationship between conditioning and anxiety.

A recent study by Lovibond (1963) investigated conditioning in relation to both neuroticism and extraversion-introversion and found that neither dimension was related to conditioning scores.

Rechtschaffen (1958) investigated extraversion-introversion as related to neural satiation and reactive inhibition. He hypothesized that extraverts would develop greater visual after-effects than introverts and that they would also develop more reactive inhibition. He found no support for either hypothesis.

It is clear from the foregoing that the relationship of conditioning to extraversion-introversion remains unclear. Eysenck (1962) wrote as follows:

> Clearly the search for a satisfactory conception of conditionability and its relation to personality variables is only at the beginning; it may be surmised that the outcome will throw new light, not only on personality development and breakdown, but also on the very concept of conditioning itself.

He stated that there were still far too many uncontrolled variables in conditioning experiments to permit decisive conclusions.

Some of the early work on the measurement of extraversion is reported by Freyd (1924) and Heidbreder (1926). Carrigan (1960) published a comprehensive review of the development of these concepts beginning

with Jung's original formulation. She concluded that these dimensions are defined differently by various psychologists, that there is no well defined evidence for the unidimensionality of these traits and that their sources are as yet unknown. Cattell (1957) presented evidence to show that it is environmental and Eysenck (1956) presented evidence which indicates that it is hereditary.

Eysenck and Eysenck (1963a) report a factor analytic study in which they investigated some of the underlying traits of extraversion. They identified two second order factors which they termed sociability and impulsiveness. They related these factors to the American conception of extraversion which emphasizes sociability and ease in interpersonal relationships, and the European conception which emphasizes impulsiveness and weak super ego controls. Eysenck and Eysenck (1963b) validated the questionnaire rating assessment of extraversion and neuroticism by comparing ratings made by others on extraverts to their self ratings on the extraversion scale. There was a high correlation between rated and self rated behavior (.88) It was somewhat lower on the neuroticism scales.

Verbal Conditioning and Personality Variables

One of the first attempts to relate conditioning to personality was that of Darrow and Heath (1932). In an extensive study which involved a large number of physiological variables and personality variables, they found extraversion to correlate with higher physiological reactivity.

Eysenck (1959) reported a study in which he found that introverts condition much more readily than extraverts in a verbal conditioning

situation. He selected neurotic extraverts and introverts using the M.P.I. and reinforced the pronunciation of words which were shown to subjects on cards. Introverts conditioned more readily than extraverts to a significant extent.

McNair (1957) showed that a subject's rate of responding verbally to pictures could be significantly influenced by verbal reinforcement and that this could take place without the awareness of the subject.

Eriksen and Kuethe (1956) showed that on a word association test subjects repressed words which were punished. They described an analogue to show that implicit verbal behavior or thoughts are S-R sequences which follow the same reinforcement laws as other behavior.

McDonell and Inglis (1962) found no significant relationship between the rate of conditioning or extinction and extraversion-introversion. They selected 65 students as subjects using the M.P.I. The experiment involved verbal conditioning in a sentence construction task.

Regarding operant conditioning, Staats (1961) related the concept of verbal habit family hierarchies to verbal meaning and verbal concepts and showed how Hull's concept of a fractional anticipatory goal response is part of the process of concept learning. He related this interpretation of meaning to operant verbal conditioning. In an earlier publication, Staats, Staats, and Biggs (1958) reported an experiment in which the meaning of verbal stimuli was changed by associating them with others which had evaluative meaning. The change in meaning was measured by a semantic differential. Color names such as red and yellow shifted in meaning to the subjects through associative conditioning.

Lipton and Blanton, (1957) studied the relationship between meaning as a dependent variable and mediated generalization. Meaning was established by pretraining on a concept formation task. Mediated generalization was measured in terms of the amount of G.S.R. conditioning. They concluded that the manipulation of experimental conditions can lead to predictable changes in meaning.

Concept Attainment and Related Variables

Baggaley (1955) interpreted some of Thurstone's work in the cognitive domain and applied it to concept formation research. He used card sorting tasks where cards varied in terms of content, number, size, and color. He found that the level of concept formation is correlated with inductive and deductive reasoning, and with the speed and strength of perceptual closure. He found also that the critical process appeared to be one of concentration on one aspect of a complex stimulus situation at a time.

Buss (1950) studied concept formation as a function of the positive and negative instances in the learning series. The task required subjects to specify whether an exemplar was positive or negative by pressing a designated key. He found that previous reinforcement had some influence upon the responses. In other words, previous learning entered into the selections which the subjects made.

Judson, Cofer, and Gelfind (1956) explored the effects of previous reinforcement on direction in problem solution. Patterns of verbal association set up by learning were found to be associated with the frequency of certain types of solutions in problems such as the Maier two string problem and his hat rack problem.

Wohlwill (1957) compared the relative strength of response to the form, color, and number dimensions of the Wisconsin Card Sorting Task. He found that when form or number were the primary reinforced concepts, they were more consistently responded to than when color was presented. He found also that form was much less readily abstracted than color or number.

Regarding the preconditioning of perception, Postman (1953) summarized some of the relevant perceptual theory. Solley and Murphy (1960) developed a theory of attention in perception indicating how it can be altered by operant conditioning. In their text they reported some unpublished research in which they conditioned the attention of children. Subjects were given two experimental tasks. In the first task they were asked to identify animal figurines which appeared in illuminated alcoves of a conditioning panel. The identification of some of these figurines was verbally rewarded whereas others were not rewarded. In a subsequent searching task, it was found that the rewarded figurines were much more readily located than the unrewarded ones. Solley and Murphy state (1960 p.189):

> New studies may help to clarify the effects of various rewarding and punishing conditions on these and other aspects of attention deployment and will, we hope, shed new light on the motivational factors guiding the developmental emergence of attention deployment as an adaptive task.

Walters (1958) studied the effects of preconditioning on perception. The colors blue and green were rewarded and red and yellow were punished in a preliminary game of steeplechase. Subjects were then required to identify simple figures in more complex ones. The latter were of the four colors mentioned above. He found that the precondi-

tioning produced a significant increase in the responses to the rewarded colors. He administered a questionnaire after the experiment to verify that the subjects were not aware of any connection between the two parts of the experiment. Walters interpreted his results in terms of conditioning and selective reinforcement. The preconditioning experiences then had the effect of increasing the probability of the subjects making certain responses over others.

Olsen and Harper (1963) studied the effects of negative preconditioning of relevant cues on a subsequent concept attainment task. Using a sample of Grade V students, they conditioned subjects aversively toward black and found that subjects made significantly more errors in concept attainment tasks where black was a relevant attribute than they did in tasks where it was not relevant. They also found that aversive conditioning to black had some negative effect on a concept where red was relevant; they attributed this to mediated generalization.

CHAPTER IV

DEFINITIONS, POSTULATES, AND HYPOTHESES

I DEFINITIONS

Because some of the terms used in this dissertation have a broad variety of meanings in psychology and education, they are here defined more precisely in order to avoid possible ambiguity.

Cognition The psychological functions by which an individual acquires codes and uses information in a problem solving situation. It therefore includes perceiving, recognizing, conceiving, judging and reasoning.

Concept A combination of attributes which elicit a common response.

Attribute Any discriminable feature of an object or event which can vary from one object or event to the next. When this feature is used to identify the attribute, it is a criterial attribute.

Conjunctive Concept A concept which requires the joint presence of several attribute values.

Concept Attainment The cognitive process involved in determining what features of the environment are relevant for grouping objects and events into previously defined classes or categories.

Concept Formation The cognitive task involved in setting up classes or categories for criterial attributes. In this sense it is primary to concept attainment.

Cue An identifying attribute which permits the discrimination and recognition of a given stimulus pattern.

Cue Affect The emotional value attached to a cue; this may be either positive or negative.

Extraversion A personality type characterized by a number of behavioral and constitutional correlates. The most important of the behavioral correlates are sociability, a love of people and social activity, a craving for action and excitement and a love of change. The typical extravert is easy-going, optimistic, and carefree, does not control his emotions rigidly and is not always reliable. The constitutional correlates as defined by Eysenck (1957, p. 114) and quoted in this dissertation are here accepted.

Introversion A personality type more or less diametrically opposed to extraversion both behaviorally and constitutionally. The behavior of the typical introvert is quiet, retiring, reserved, introspective and carefully controlled. The introvert does not like excitement, is seldom aggressive, and is reliable though somewhat pessimistic. The constitutional correlates as defined by Eysenck (loc, cit.) are here accepted.

II POSTULATES

In continuation of the theoretical background outlined in Chapter II, the major postulate of this dissertation may be stated as follows:

Postulate Cognitive functions are related to previous learning and to the personality traits of the individual.

III HYPOTHESES

The major hypotheses derived from the postulate above are as follows:

Major Hypothesis I Concept attainment performance can be altered by previous learning in the form of operant verbal conditioning.

The experimental hypotheses which follow from this are:

1. In a concept attainment task of a high level of difficulty, individuals who are conditioned to avoid attributes which are relevant to these concepts will perform at a lower level than similar individuals who have not been so conditioned.

2. The differences in performance between the two groups will be most pronounced on concept attainment tasks where the conditioned attribute is relevant.

3. The differences in performance between the two groups will be less pronounced on concept attainment tasks where the conditioned attribute is irrelevant.

Major Hypothesis II The change in concept attainment performance resulting from verbal conditioning is related to the personality dimensions of extraversion and introversion.

The experimental hypothesis which follows from this is as follows:

1. Introverts will condition more readily than extraverts and will therefore show a lower performance than extraverts in a cognitive task where both groups have been conditioned to avoid relevant cues.

CHAPTER V

THE EXPERIMENT PART I

THE SAMPLE AND EXPERIMENTAL PROCEDURE

The present chapter outlines the general design of the experiment and describes the first stages of the procedure including a description of the tests used, the procedure in selecting the sample, and the treatment given to the various groups.

I INTRODUCTION

Experimental Design

Using the Maudsley Personality Inventory, a sample of 80 subjects, 40 extraverts and 40 introverts, was drawn from three classes of first and second year students in educational psychology. A concept attainment test was also given to the three classes. Subjects were then arranged into experimental and control groups of 40 each such that there were 20 extraverts and 20 introverts in each subgroup. The general arrangement is outlined in Figure I. The experimental and control groups were then matched on the basis of group means with reference to extraversion, introversion, sex, and performance on the Concept Attainment Test.

Subjects were then tested individually using the same concept attainment test as that used in the sampling procedure. Subjects in the experimental group were given a semantic differential on color and then a form discrimination test which was designed to produce an avoidance of the shaded figures on the Concept Attainment Test. They were then given the Concept Attainment Test after which they completed another copy of the semantic differential. Subjects in the control group went through

	Extraverts	Introverts
Exp. Group	Females - 10	Females - 10
	Males - 10	Males - 10
Control Group	Females - 10	Females - 10
	Males - 10	Males - 10

Figure I

Arrangement of subjects in the experimental design

the same procedure except that they were not given the form discrimination test. The effects of the conditioning procedures were then studied by a comparison of the concept attainment scores using an appropriate three way analysis of variance design. The pretest and posttest ratings of the experimental and control subjects of the concept black on the relevant scales of the semantic differential were also compared.

II DESCRIPTION OF TESTS

Maudsley Personality Inventory

The inventory (Eysenck, 1959a) consists of 48 items; 24 of these are designed to measure neuroticism or emotionality and the remaining 24 are designed to measure extraversion. Theoretically, the dimensions of extraversion and neuroticism are completely independent. Correlations between the scales have been found to be about -.15. These were derived from some 20 different samples and are reported in the manual. Coefficients of reliability are reported which range from .85 to .90 for the neuroticism scale and from .80 to .85 for the extraversion scale. These were obtained using both the Kuder-Richardson and split-half methods. With reference to concurrent validity, a correlation of .92 was obtained between the Extraversion Scale of the M.P.I.[1] and the Guilford C Scale of the Guilford Zimmerman Temperament Survey.

The mean values of the two scales of the M.P.I. obtained for the experimental sample and for the standardization population are presented in Table I for comparison. The mean values for the extraversion scores of the two groups compare favorably which is some indication of a reliable measure.

---

[1] Maudsley Personality Inventory. Hereafter abbreviated M.P.I.

TABLE I

A COMPARISON OF STANDARDIZATION VALUES AND SAMPLE VALUES OBTAINED ON THE DIMENSIONS OF EXTRAVERSION AND NEUROTICISM

	Sample Values		Standardization Values[1]	
	Mean	S.D.	Mean	S.D.
Extraversion Scores	27.30	9.23	28.53	8.28
Neuroticism Scores	25.13	9.87	20.91	10.69

---

[1] Obtained from a population of 1500 American students

Sociability-Impulsiveness Scale

This scale (Appendix A) consists of 37 items drawn from the 66 listed in the research report by Eysenck and Eysenck (1963b). The criterion of selection was a minimum factor loading of .25 on the extraversion factor. This yielded 20 items relevant to sociability and 17 items relevant to impulsiveness. In their research report, Eysenck and Eysenck describe sociability and impulsiveness as second order factors of extraversion. They report a correlation of these factors of the order of .50. The items on the respective scales were designed to distinguish two different kinds of extraverts: the sociable and the impulsive. The sociable extravert conforms to the American conception of extraversion which stresses a relative lack of super ego controls and a tendency to act on the spur of the moment.

The Concept Attainment Test

This test is adapted from the concept attainment research of Bruner, Goodnow, and Austin (1956). Whereas the latter used circles, squares, and crosses as symbols, the test used in this study is based on triangles, circles, and squares. The color dimension is represented by black or shaded figures, striped figures, and white or clear figures. A full scale example of the figures is given in Figure II. These were drawn on 5" by 8" pieces of white cardboard. The four attributes used to define the concepts are as follows:

1. Number of figures. This refers to the total number of figures on the card where the possible alternatives are 1, 2, or 3.

2. Kind of figures. Here any combination of circles, triangles or squares is possible.

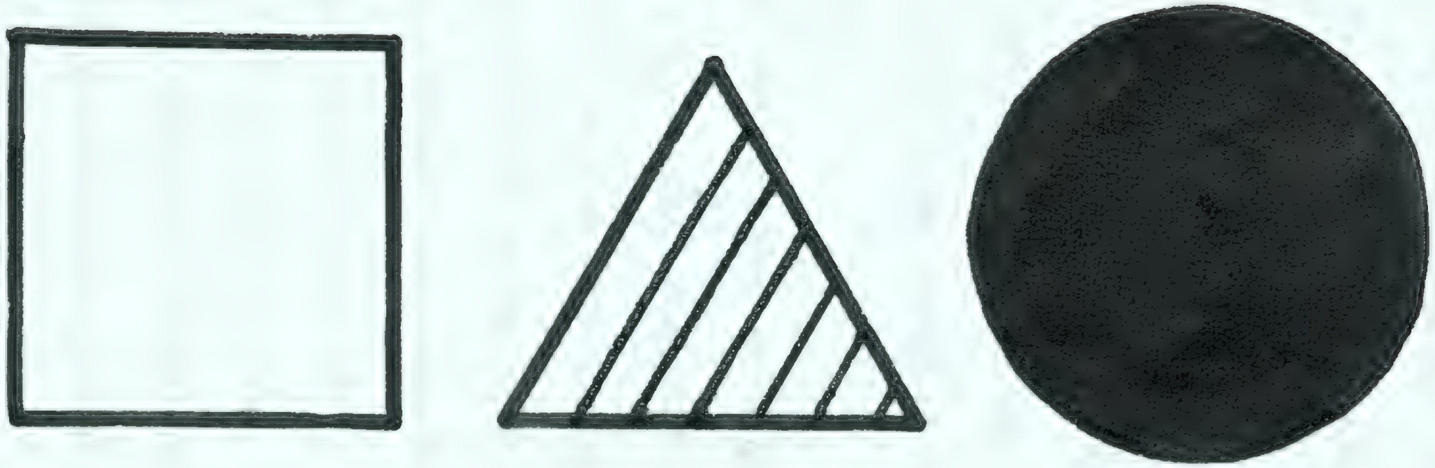

FIGURE 2

Example of the figures used in the Concept Attainment Test. (The border is not shown)

3. Shading of figures where any combination of clear, striped, or shaded figures is possible.

4. Number of borders where the possibilities are either none, or one, or two.

The test consists of 12 problems the first two of which are practice problems; the remaining 10 constitute the main series. The task in each problem consists of identifying a given concept from a series of six cards which are viewed in succession at intervals of approximately 10 seconds each. On the basis of the information given by the cards and with the examiner's indication of whether each card was positive or negative, subjects are required to identify the determining attributes of the concept.

Generally the test was constructed to provide a novel cognitive task for the subjects; a task which includes the ability to perceive detail, to remember details and to make logical inferences from these. It is relatively unambiguous and can be readily explained with a few examples. Specifically, subjects must make the right hypotheses about the nature of the concept within a very short time after seeing each exemplar or card. The limited exposure time for each card resulted in a high level of difficulty which was considered necessary in order to reveal the effects of the conditioning procedures and of course to provide the subjects with a challenging task.

The Form Discrimination Test

The form discrimination test was constructed to provide a series of difficult problems in form perception and memory for details of form. It consists of 12 items which are arranged in the form of a mul-

tiple choice series. In each item, subjects are shown an irregularly shaped figure on a sample card for approximately 10 seconds. The sample card of item 10 is shown in Figure 3. The sample card is then withdrawn and a sheet containing four figures identical to the sample in color and with slight variations in form is shown. The task then is to select the figure which most resembles the sample. The figures are arranged on the sheet so that the four possible responses are: *upper right*, *upper left*, *lower right*, *lower left*. Items 2, 4, 5, 7, 10, 11, and 12 are made up of black figures identical in shading to the black figures of the Concept Attainment Test. The remaining ones are green, red, and blue.

The Semantic Differential

A semantic differential on color, termed *Color Rating Questionnaire* (Appendix A), was prepared in an attempt to measure differences in response to black as a result of the experimental treatment. More specifically, its purpose was to find whether there was a shift in the connotative meaning of the color black as a result of the conditioning procedures. The color black itself was included among three others, white, dark, and green in order to provide a questionnaire of suitable length for good test rapport. On the differential for each color, there are 10 seven point bipolar scales. These include Osgood's dimensions of evaluation, potency, and activity as well as seven others selected from a number of lists in Osgood, Suci, and Tannenbaum (1956). Most of the latter dimensions had some possible relevance to the connotative meaning of color.

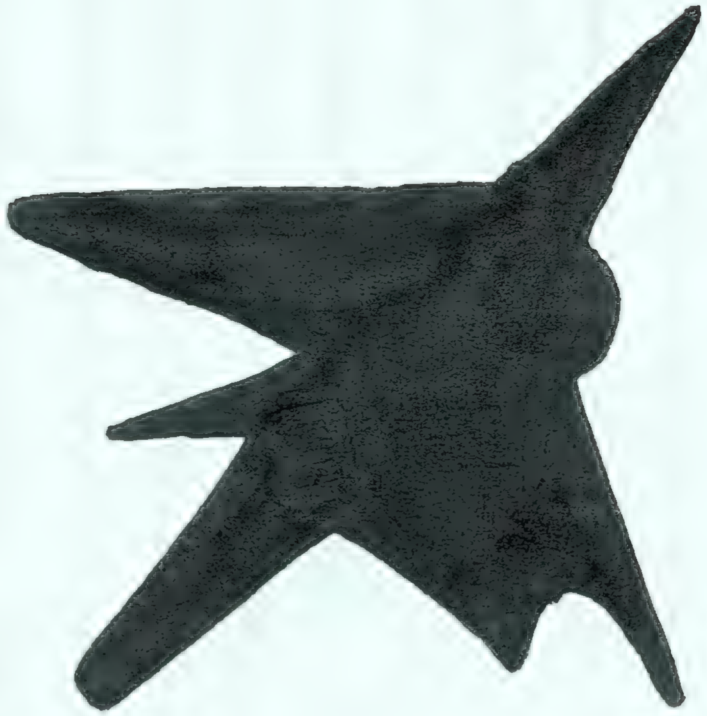

FIGURE 3

Diagram of the figure used in Item 10 of the Form Discrimination Test

III THE SAMPLE

The experimental population was obtained from the students enrolled in first year educational psychology in the Faculty of Education. The M.P.I. and the Sociability-Impulsiveness Scale were given to 137 students. These students constituted 3 separate classes of about 45 students each. Both questionnaires were administered at the same time. The results of the M.P.I. for these classes as well as for the total sample are summarized in Table II.

Extraverts and introverts were then selected on the basis of their deviation from the mean score on the scale. Standard deviation values of .75 on either side of the mean were selected to define the limits. That is to say, those individuals who were above .75 S.D. and below -.75 S.D. were included in the sample. To the nearest whole number, .75 S.D. is equivalent to 7 score points so that the limits were therefore 7 above and below the group mean of 27. Accordingly introverts included those with a score of 20 and below and extraverts included those with a score of 34 and above. This established a score distance of 1.5 S.D. values between the highest scoring introverts and the lowest scoring extraverts. Using this selection criterion, a total of 89 subjects remained in the sample. Since the means and standard deviations of the scores of the three classes were comparable, approximately equal numbers were selected from each class.

The Concept Attainment Test was given to the same classes some weeks later. Six students who took the personality questionnaires and were selected were absent and had to be discarded from the sample since concept attainment scores were not available for them. The scores of

TABLE II

SUMMARY OF THE STATISTICS ON EXTRAVERSION-INTROVERSION SCORES FOR THE 3 CLASSES AND THE TOTAL SAMPLE

	Number	Mean	S.D.
Class I	46	28.50	8.51
Class II	46	27.60	9.64
Class III	45	26.33	9.41
Total	137	27.30	9.23

the three classes were first analysed separately and then combined. The range of marks out of a possible 40 was 12 - 38, and the distribution was approximately normal. Statistics of the scores for the three classes and the total group are summarized in Table III. The 83 subjects who were selected according to the extraversion-introversion criteria outlined above, and for whom concept attainment scores were available were then arranged into experimental and control groups according to the design outlined in Figure 1. The experimental and control groups therefore consisted of 20 extraverts and 20 introverts in each group. The numbers were matched in terms of sex so that the 20 subjects in each case consisted of 10 males and 10 females . The three subjects which remained after this procedure were kept as reserve in the event that any one of the subjects selected would not be available at the time of the experiment. Two were eventually used in this manner. The data given in Tables IV to VII inclusive refer to the final sample of subjects who took part in all phases of the experiment. In the arrangement of the subjects, approximately equal numbers from the three classes were placed into the experimental and control groups to insure near random selection.

The experimental and control groups and subgroups were matched on the basis of mean scores on extraversion, introversion and concept attainment. The statistics for extraversion and introversion scores of the major subgroups and a summary of the t tests for significance of difference between the means are presented in Table IV. The statistics for the sociability and impulsiveness scores of the major subgroups and a summary of the t tests for significance of difference between the means are given in Table V. Table VI presents the statistics and t tests

for the significance of difference between means on sociability and impulsiveness scores for the extraverts and introverts of the final sample. The statistics and t tests for the significance of difference between means on concept attainment scores for the experimental and control groups and subgroups are presented in Table VII.

Comparison of Groups

the statistics presented in Table IV indicate that there are no significant differences between corresponding experimental and control groups on the dimensions of extraversion and introversion. Table V indicates no significant differences between the experimental and control groups or subgroups on the sociability or impulsiveness scores. Table VI indicates that the extraverts as a group and introverts as a group, including both experimental and control groups in each case, differ significantly in their sociability and impulsiveness scores. Table VII indicates no significant differences between the means on concept attainment scores for the experimental and control groups and subgroups, for extraverts and introverts (combined experimental and control groups) and for males and females (combined experimental and control groups). The experimental and control groups were therefore considered to be equated on the dimensions of extraversion, introversion and concept attainment. It was also considered that there were no differences in concept attainment performance relative to sex or extraversion.

TABLE III

SUMMARY OF THE STATISTICS OF THE CONCEPT ATTAINMENT SCORES OF THE THREE CLASSES AND THE TOTAL GROUP

	Number	Mean	S.D.
Class I	39	23.86	6.04
Class II	43	26.39	6.21
Class III	42	27.71	5.41
Total	124	26.01	5.94

TABLE IV

SUMMARY OF STATISTICS AND t TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS OF EXTRAVERSION AND INTROVERSION SCORES FOR THE FINAL SAMPLE

Extraversion	N	Mean	S.D.	Mean Diff.	t	Sig.
Exp. Group	20	36.45	3.02	.30	.02	NS
Con. Group	20	36.75	3.23			
Males	20	36.00	2.93	1.20	.100	NS
Females	20	37.20	3.21			
Introversion						
Exp. Group	20	16.70	4.59	1.00	.18	NS
Con. Group	20	15.70	4.68			
Males	20	16.25	5.05	0.10	.01	NS
Females	20	16.15	4.25			

TABLE V

SUMMARY OF STATISTICS AND t TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS ON SOCIABILITY AND IMPULSIVENESS SCORES FOR THE FINAL SAMPLE

Sociability	N	Mean	S.D.	Mean diff.	t	Sig.
Exp. Group	40	10.65	5.30	0.32	0.12	NS
Con. Group	40	10.97	5.57			
Exp. Extraverts	20	15.30	2.49	0.40	0.16	NS
Con. Extraverts	20	15.70	2.47			
Exp. Introverts	20	6.0	2.60	0.25	0.09	NS
Con. Introverts	20	6.25	3.36			
Impulsiveness						
Exp. Group	40	7.72	3.53	0.75	0.40	NS
Con. Group	40	6.97	3.74			
Exp. Extraverts	20	8.70	3.77	1.00	0.31	NS
Con. Extraverts	20	9.70	2.70			
Exp. Introverts	20	6.75	2.96	2.50	1.23	NS
Con. Introverts	20	4.25	2.45			

TABLE VI

SUMMARY OF STATISTICS AND t TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS ON SOCIABILITY AND IMPULSIVENESS SCORES FOR EXTRAVERTS AND INTROVERTS OF THE FINAL SAMPLE

Sociability	N	Mean	S.D.	Mean diff.	t	Sig.
Extraverts	40	15.50	2.49	9.38	3.42	$p<.01$
Introverts	40	6.12	3.01			
Impulsiveness						
Extraverts	40	9.20	3.31	3.70	1.99	$p<.05$
Introverts	40	5.50	2.98			

TABLE VII

SUMMARY OF STATISTICS AND t TESTS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS ON CONCEPT ATTAINMENT SCORES FOR EXPERIMENTAL AND CONTROL GROUPS AND SUBGROUPS

	N	Mean	S.D.	Mean diff.	t	Sig.
Exp. Group	40	26.40	5.25	0.65	0.12	NS
Con. Group	40	25.75	6.16			
Extraverts	40	26.22	5.46	0.30	0.05	NS
Introverts	40	25.92	5.99			
Males	40	25.60	5.51	0.95	0.14	NS
Females	40	26.55	5.91			
Exp. Extraverts	20	26.70	4.70	0.60	0.68	NS
Exp. Introverts	20	26.10	5.74			
Exp. Males	20	26.71	5.11	0.60	0.05	NS
Exp. Females	20	26.11	5.37			

IV TREATMENT

During the second term of the academic year, the students who were selected as subjects were contacted by the experimenter during lecture hours and were asked to participate in the experiment. A three week time table was prepared and subjects selected one hour between 9:00 A.M. and 4:00 P.M. which was suitable to their own time tables. All testing was carried out in the same counselling room with the exception of three subjects who were tested in a vacant office.

Experimental Procedure

In the experimental procedure, subjects were first given a general orientation to the room and asked to fill out a copy of the semantic differential. Little introduction was given in the administration of this scale; the written instructions were considered to be adequate although all questions were promptly answered.

Subjects in the experimental group were then given the form discrimination test. The instructions as described in Appendix B were adhered to and responses were recorded to insure that the subject had normal vision and that test rapport was good. Regardless of the correctness of the response, subjects were positively reinforced for their selections on the red, blue, and green items and were negatively reinforced on the black items. The black items were slightly more difficult than the rest but not conspicuously so. Positive reinforcement took the form of examiner comments such as "excellent, very good," and "best choice". Negative reinforcement took the form of comments such as "No" and "Wrong". This test was omitted in the procedure for the control subjects.

Both experimental and control subjects were given the Concept Attainment Test. All subjects were told that the test is the same as the one given in the group administration during the previous term. The introduction as stated in Appendix B was used and two practice problems were given before beginning the main series. The learning criterion was a perfect answer to the two practice problems. If this was not reached the errors were explained and another problem was given. An extra one was available for this purpose. In nearly all cases the first explanation was sufficient and subjects were successful on the two practice problems. The main series was then given without further pause or comment. Cards were arranged in a definite order and were presented to all subjects in that order. A blank card appeared after the sixth card of each problem; this indicated to the subjects that all the information toward the solution of that problem had been given.

After the Concept Attainment Test, subjects were asked to fill in another copy of the semantic differential. They were told that it was exactly the same as the first one and that the reason for a second measure was partly one of the measurement of reliability coefficients for the various scales. There was no suggestion that the semantic differential was in any way connected with the rest of the experiment. Test rapport was good with all subjects and the entire procedure required 30 to 40 minutes for each subject.

Collection of Data

The semantic differentials were numbered according to the order in which they were given to each subject. A number was assigned to each point on the scale in the following manner: the neutral positions

were given a value of 0 and the remaining ones were given values of 1, 2, and 3 successively. Positive and negative signs were used to indicate the direction of choice. Using this system, subjects' responses on the ten scales of the concept black were recorded on a data sheet.

The answer sheets of the Concept Attainment Test were scored on the basis on one mark for the correct information under each of the four attribute headings. This yielded a maximum of 40 marks. Two subscores and the total score were recorded as follows:

1. The sum of the scores on the items where shading was relevant, namely items 4, 7, 9, and 10.
2. The sum of the scores on items where shading was irrelevant, namely items 1, 2, 3, 5, 6, and 8.
3. The total score.

CHAPTER VI

THE EXPERIMENT PART II
ANALYSIS OF DATA AND STATEMENT OF RESULTS

The present chapter describes the second stage of the experiment which includes the analysis of experimental data and statement of results. The analysis of data is divided into two major headings: one describes the analysis of the concept attainment scores and the other that of the semantic differential data.

I CONCEPT ATTAINMENT SCORES

The experimental results of the Concept Attainment Test are summarized in Tables VIII, IX, and X. Table VIII presents the means and standard deviations of the experimental and control groups and subgroups for the total concept attainment scores. Table IX presents the same data on the concept attainment subscores for the four items where black was relevant, and table X presents the same data for the six items where black was irrelevant. A comparison of Table VIII with Table VII shows that the mean performance of the experimental group was reduced by more than two points from the performance on the group administration of the test used in selecting the sample. The mean of the control group, on the other hand, rose by more than two points. It is perhaps of interest to note also that the variance of both groups was somewhat reduced in the experimental administration of the test.

A comparison of the subgroups reveals that the difference between the mean performance was greater on the experimental results (Table VIII) for the introverts than it was for the extraverts. Similarly, the female groups differed by more than five points whereas the males differed

TABLE VIII

STATISTICAL SUMMARY OF THE EXPERIMENTAL RESULTS OF THE CONCEPT ATTAINMENT TEST. TOTAL SCORES FOR EXPERIMENTAL AND CONTROL GROUPS AND SUBGROUPS

	N	Mean	S.D.
Experimental Group	40	24.05	4.99
Control Group	40	27.90	4.38
Exper. Extraverts	20	24.40	4.94
Control Extraverts	20	27.80	4.82
Exper. Introverts	20	23.70	5.02
Control Introverts	20	28.00	3.89
Experimental Males	20	24.00	4.87
Control Males	20	26.40	3.65
Experimental Females	20	24.10	5.12
Control Females	20	29.40	4.53

TABLE IX

STATISTICAL SUMMARY OF THE EXPERIMENTAL RESULTS OF THE CONCEPT ATTAINMENT TEST. SUBSCORES ON FOUR ITEMS: BLACK RELEVANT

	N	Mean	S.D.
Experimental Group	40	8.20	2.78
Control Group	40	10.25	2.11
Experimental Extraverts	20	8.75	2.50
Control Extraverts	20	10.75	2.16
Experimental Introverts	20	7.65	2.93
Control Introverts	20	9.75	1.94
Experimental Males	20	8.20	2.29
Control Males	20	9.70	2.78
Experimental Females	20	8.20	3.20
Control Females	20	10.80	2.35

TABLE X

STATISTICAL SUMMARY OF THE EXPERIMENTAL RESULTS OF THE CONCEPT ATTAINMENT TEST. SUBSCORES OF THE EXPERIMENTAL AND CONTROL GROUPS AND SUBGROUPS ON SIX ITEMS: BLACK IRRELEVANT

	N	Mean	S.D.
Experimental Group	40	15.85	3.13
Control Group	40	17.65	2.96
Experimental Extraverts	20	15.65	3.10
Control Extraverts	20	17.05	3.34
Experimental Introverts	20	16.05	3.15
Control Introverts	20	18.25	2.40
Experimental Males	20	15.80	3.34
Control Males	20	16.70	2.70
Experimental Females	20	15.91	2.91
Control Females	20	18.60	2.92

only by some two and one-half points. The means for the corresponding groups on the sample test are not given in Table VII. They were 24.50 for the males and 27.00 for the females which is some explanation for the wider difference in the experimental results.

Analysis of Data

The source of differences between the performance of the experimental and control groups was investigated using a three-way analysis of variance design (Winer, 1962, p. 248). This is the common design used for a 2 x 2 x 2 factorial experiment with equal numbers in each cell. An F Test for homogeneity of variance (Winer, 1962, p. 240) was carried out to insure that this design was valid for the data. The F_{max} value was found to be insignificant in each case and therefore the requirements of the design were met.

The analyses of variance were carried out; one on the total scores and one on each of the subscores. The results of these analyses are summarized in Tables XI, XII, and XIII. A further analysis was then carried out on the scores of the experimental groups only. This was a test for simple effects. The analyses of the total scores and of the scores on the six items where black was irrelevant yielded very insignificant results; the F values were less than 0.5. The test for simple effects on the scores of the four items where black was relevant is summarized in Table XIV.

TABLE XI

SUMMARY OF THE ANALYSIS OF VARIANCE OF THE CONCEPT ATTAINMENT SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS ON THE TOTAL TEST.

Source of Variation	SS	df	MS	Obtained F value	Sig.
Factor A Experimental vs Control Group	296.45	1	296.45	13.00	$p < .01$
Factor B Extraverts vs. Introverts	1.45	1	1.45	.006	NS
Factor C Males vs Females	48.05	1	48.05	2.10	NS
AB Interaction	3.85	1	3.85	0.16	NS
AC Interaction	42.05	1	42.05	1.84	NS
BC Interaction	21.85	1	21.85	0.95	NS
ABC Interaction	6.25	1	6.25	0.27	NS
Error (within cell)	1642.0	72	22.80		
Homogeneity of Variance			F_{max} =	2.51	NS

TABLE XII

SUMMARY OF THE ANALYSIS OF VARIANCE OF THE CONCEPT ATTAINMENT SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS ON THE FOUR ITEMS WHERE BLACK WAS RELEVANT

Source of Variation	SS	df	MS	Obtained F value	Sig.
Factor A Experimental vs Control Group	84.05	1	84.05	13.41	$p < .01$
Factor B Extraverts vs. Introverts	22.05	1	22.05	3.52	NS
Factor C Males vs. Females	6.05	1	6.05	0.96	NS
AB Interaction	0.05	1	0.05	0.007	NS
AC Interaction	6.05	1	6.05	0.965	NS
BC Interaction	4.05	1	4.05	0.64	NS
ABC Interaction	0.45	1	0.45	0.07	NS
Error (within cell)	451.2	72	6.267		
Homogeneity of Variance			F_{max} =	3.71	NS

TABLE XIII

SUMMARY OF ANALYSIS OF VARIANCE OF THE CONCEPT ATTAINMENT SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS ON THE SIX ITEMS WHERE BLACK WAS IRRELEVANT

Source of Variation	SS	df	MS	Obtained F value	Signif. Level
Factor A Experimental vs Control Group	64.80	1	64.80	6.83	$p<.01$
Factor B Extraverts vs Introverts	12.80	1	12.80	1.35	NS
Factor C Males vs Females	20.00	1	20.00	2.12	NS
AB Interaction	3.20	1	3.20	0.34	NS
AC Interaction	16.20	1	16.20	1.71	NS
BC Interaction	7.20	1	7.20	0.76	NS
ABC Interaction	3.20	1	3.20	0.34	NS
Error (within cell)	683.60	72	9.494		
Homogeneity of Variance			F_{max} =	3.36	NS

TABLE XIV

SUMMARY OF THE ANALYSIS OF VARIANCE OF CONCEPT ATTAINMENT SCORES FOR SIMPLE EFFECTS OF FACTOR B (EXTRAVERSION - INTROVERSION) AT LEVEL a_1 OF FACTOR A (EXPERIMENTAL vs CONTROL)

Source of Variation	SS	df	MS	Obtained F value	Sig.
Factor B for Level a_1	24.2	1	24.2	3.86	$p<.07$
Error Variance	451.2	72	6.267		

Statement of Results

An examination of the F values in Tables IX to XIV indicates the following:

1. There is a significant difference between the experimental and control groups on the total concept attainment scores and on each of the subscores.

2. The difference is most significant on the subscores of the items where black was relevant and almost as significant on the total scores.

3. The difference is least significant on the subscores where black was only negatively relevant.

4. The differences between extraverts and introverts are all non-significant at the .05 level. They are significant however at the .10 level on the subscores where black was relevant.

5. Sex differences are all non-significant.

6. All interactions between the various factors are non-significant.

7. The difference between the extraverts and introverts of the experimental group is somewhat closer to significance at the .05 level than the difference between extraverts and introverts of the entire sample. (Compare F values for Factor B, Tables XII and XIV)

II SEMANTIC DIFFERENTIALS

Analysis of Data

The semantic differential data were analysed using a method of vector addition. As outlined in Chapter V, the neutral interval on each scale was assigned a value of zero and the rest were given positive and negative values ranging from one to three as follows:

Good 3 2 1 0 -1 -2 -3 Bad

This was selected in preference to positive values ranging from 1 to 7 so that the origins of the axes were at zero and positive and negative values would indicate the direction of a shift at a glance. Only the six scales listed in Table XV are reported in the analysis. The rest did not appear to be relevant to the concept black in terms of the connotative meanings which might be affected by the conditioning procedures. A summary of the ratings of the experimental and control subjects is given in Table XV. Column II represents the algebraic sum of the ratings of the subjects in that group on the scale indicated. It is listed as column II because it is the rating which the individuals made after the test. Column I is a similar sum for the pretest ratings. Column II - I represents the difference between the columns which indicates both the direction and degree of shift occurring between the two ratings.

A negative value represents a shift toward the negative pole of the scale and alternately a positive value represents a shift towards the positive pole. The scales in the tables are always listed with the positive poles first. The mean shift was obtained by dividing the

TABLE XV

A SUMMARY OF THE SEMANTIC DIFFERENTIAL RATINGS OF THE CONCEPT BLACK

Experimental Group	II	I	(II - I)	Mean Shift
Good - Bad	-45	-8	-33	-0.825*
Strong - Weak	68	81	-13	-0.324
Active - Passive	13	14	-1	-0.025
Pleasant - Unpleasant	-39	-28	-11	-0.275
Beautiful - Ugly	-24	-20	-4	-0.100
Happy - Sad	-62	-70	8	0.200
Control Group				
Good - Bad	-37	-44	7	0.175
Strong - Weak	65	81	-16	-0.40
Active - Passive	10	5	5	0.125
Pleasant - Unpleasant	-26	-40	14	0.35
Beautiful - Ugly	-24	-18	-6	-0.15
Happy - Sad	-75	-81	6	0.15

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*Significant at the .02 level. (Osgood, Suci and Tannenbaum, 1957, Table 21, p.139)

total shift in Column (II - I) by 40 which is the number of individuals in each group. This represents the average amount of shift for each individual.

In order to represent the results graphically, it was necessary to establish the relative orthogonality of the scales. If the scales are significantly related in any way, they can not be represented by perpendicular axes. Accordingly the values in Column I for each of the subjects in the main data sheets were converted to a seven point scale by adding a constant of 4. This amounted to a shifting of the origin to 4 from 0 and thereby eliminating the negative values. Pearson Product Moment correlations were then calculated between subjects' ratings on the first four scales of Table XV. They are given in Table XVI. The correlation values indicate that evaluation and potency are independent scales and that the activity scale is independent of the *pleasant* - *unpleasant* scale. Accordingly these scales were paired for the purposes of representing the data graphically. The generalized distance formula:

$$d = \sqrt{(X_1 - X_2)^2 \quad (Y_1 - Y_2)^2}$$

was used to calculate the absolute distance of shift between the first rating and the second. In the formula:

d = the distance in semantic units

X_1, Y_1 are the co-ordinates of the first ratings of the concepts on the respective scales

X_2, Y_2 are the co-ordinates of the second rating of the concepts on the respective scales

The d values obtained for the experimental and control groups on the various scales are given in Table XVII.

TABLE XVI

CORRELATIONS BETWEEN SUBJECTS' RATINGS OF THE CONCEPT BLACK ON FOUR SCALES OF THE SEMANTIC DIFFERENTIAL

Scales	Correlations
Good - Bad vs Active - Passive	.15
Good - Bad vs Pleasant - Unpleasant	.35*
Good - Bad vs Strong - Weak	-.05
Active - Passive vs Pleasant - Unpleasant	.09

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*Significant at the .05 level. (Guilford, 1956, p.219)

TABLE XVII

D VALUES OBTAINED BETWEEN FIRST AND SECOND RATINGS OF THE EXPERIMENTAL AND CONTROL GROUPS OF THE CONCEPT BLACK ON THE SEMANTIC DIFFERENTIAL

Axes of the Graph	Exp. Group	Con. Group
Good - Bad and Strong - Weak	39.2	17.5
Active - Passive and Pleasant - Unpleasant	11.01	14.8

Statement of Results

An examination of the mean shift values in Tables XV indicates that the only shift significant at the .02 level occurred for the experimental group on the evaluation scale. All other values do not approach this level. Generally the figures indicate the following:

1. On the evaluation scale, the shift was strongly negative for the experimental group and slightly positive for the control group.

2. On the potency scale, the shift was almost equally negative for both groups.

3. There was relatively little shift on the activity scale.

4. On the pleasant - unpleasant scale there was a negative shift on the part of the experimental group and a slightly higher positive shift on the part of the control group.

5. There was very little difference between the experimental and control groups on the remaining scales. The strongly negative rating of the concept black on the happy - sad scale on the part of both the experimental and the control groups is a strong indication of a stable cultural value.

The correlations between the scales considered are all insignificant except that obtained between the evaluative and pleasant - unpleasant scale. The obtained distance values (Table XVII) indicate that the greatest shift on the concept black occurred for the experimental group on the evaluation scale relative to the potency scale. The shift was similar for the experimental and control groups on the activity and pleasant - unpleasant scales.

III ADDITIONAL ANALYSES

Since the F Tests did not reveal any significant differences in the concept attainment scores other than those which exist between the experimental and control groups, further analyses were not undertaken. Had the differences between extraverts and introverts been significant, the dimensions of sociability and impulsiveness might have shed further light on the reasons for these differences. Similarly, if there had been sex differences, these dimensions might have been used toward a further analysis.

Although neuroticism was not originally considered in the experimental hypotheses, scores for all subjects were available since these are also a part of the personality inventory used in the selection of the sample. A summary of the statistics for the neuroticism scores of both the experimental and control groups is given in Table XVIII. The means of the two groups are so similar that a t test for significance of difference was considered unnecessary.

Further analysis was carried out on subjects whose scores on the M.P.I. indicated high neuroticism and those whose scores indicated stability. Two groups were selected from the 40 subjects in the experimental group; the following criteria were used:

1. Neuroticism scores of 30 and up for high N subjects.
2. Neuroticism scores of 20 and down for low N subjects.

Mean performances for these groups on the group administration of the Concept Attainment Test were compared to their mean performance after conditioning. On the basis of the results of the analysis of variance, the latter means used were derived from the scores on the four items

TABLE XVIII

SUMMARY OF THE STATISTICS OF THE NEUROTICISM SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS

	N	Mean	S.D.
Experimental Group	40	26.07	10.03
Control Group	40	26.05	9.19

where black was relevant. The statistics are given in Table XIX. The results indicate that the high N group did less well on the pretest than the low N group. On the pretest, the difference between the means of the two groups is 2.83 and on the posttest, the difference is 2.22 score points with the lower mean still that of the high N group. The change was not considered significant enough to warrant a t test.

Finally, A.C.E.[1] scores were available for 62 subjects in both the experimental and control groups. Evidence as to the nature of the abilities involved in the Concept Attainment Test was sought by correlating the scores of the group concept attainment test given in the sampling procedure with each of the Q and L subscores of the A.C.E. The correlations are given in Table XX. Both correlations are too low to be of any significance for this sample size.

SUMMARY

The results of the experiment indicate that there was a significant difference between the experimental and control groups on the concept attainment scores. Differences were most significant on the four items where black was relevant, somewhat less significant on the total scores and least significant on the six items where shading was only negatively relevant. The latter was still significant at the .05 level however.

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[1] American Council on Education Psychological Examination. (Q scores refer to quantitative subtests and L scores to language subtests.)

TABLE XIX

SUMMARY OF THE STATISTICS OF HIGH N AND LOW N GROUPS ON NEUROTICISM AND ON PRETESTS AND POSTTESTS OF CONCEPT ATTAINMENT

	N	Neur. M.	S.D.	Pretest Con. Attain. M.	S.D.	Posttest Con. Attain. M.	S.D.
High N Group	15	34.86	5.67	25.00	5.56	7.53	3.47
Low N Group	12	14.41	4.71	27.83	8.76	9.75	2.16

TABLE XX

COEFFICIENTS OF CORRELATION BETWEEN CONCEPT ATTAINMENT PRETEST SCORES AND A.C.E. Q AND L SUBSCORES

	N	Correlation r.
Concept Attainment Scores vs Q Subscores	62	-.08
Concept Attainment Scores vs L Subscores	62	.15

The extraversion and introversion subgroups showed no significant differences on either of the subscores or on the total scores of the Concept Attainment Test. Sex differences were non-significant as were all interactions between the major factors.

The results of the F Test for simple effects, where the subgroups of the experimental group only were compared, are in agreement with the previous F Tests on the entire population sample. No significant differences were found although the difference between the experimental extraverts and experimental introverts was significant at the .07 level.

The analysis of the pretest and posttest semantic differentials for the concept black indicated a significantly negative shift on the evaluative scale for the experimental group and a slightly positive shift for the control group. There was a smaller negative shift for both groups on the potency scale and little shift for both groups on the activity scale. The shifts of the two groups on the pleasant - ugly scale were very much like the shifts on the evaluative scale. There was very little difference between the experimental and control groups on the remaining scales.

An intercorrelation of the four scales evaluation, potency, activity and pleasant - unpleasant revealed no significant relationship between ratings with the exception of the evaluative scale and the pleasant - unpleasant scale.

A comparison of the pretest concept attainment scores of the subjects in the experimental group with the test scores attained after the conditioning procedures revealed no differences between subjects who scored high on the Neuroticism Scale and those who scored low on this scale.

Finally, a correlation of the concept attainment pretest scores with the subscores on the A.C.E. Test revealed no significant relationships.

CHAPTER VII

THE EXPERIMENT PART III
DISCUSSION AND CONCLUSIONS

The present chapter presents a discussion of the experimental results and the conclusions drawn from the findings. The discussion of results includes the relationship of the findings to previous research and describes a number of causal factors underlying the results The conclusions are drawn with reference to the original hypotheses and finally the limitations of the conclusions are discussed.

I DISCUSSION

The results of the experiment indicate that the experimental procedure had the effect of a significant reduction of the concept attainment scores of the experimental group relative to the control group. The increase in the mean performance of the control group can be explained on the basis of the experimental procedure. In the experiment, tests were administered individually and it was therefore possible to control a number of extraneous variables which were not controlled in the group administration of the test. The concept attainment test represented a relatively novel task for the subjects and therefore the learning factor can account for a good deal of variance in the scores. In the experimental administration of the test, it was possible to adopt and maintain a learning criterion. This had the effect of eliminating errors which resulted from a lack of understanding of the tasks involved in the test and helped to reduce the variance resulting from differential learning rates. The variance of the control group and sub-

groups is also lower in most cases which is further evidence that some of the subjects who scored low on the pretest scored considerably higher on the posttest. It was possible also to control other variables such as the distance of the subjects from the stimulus cards and the strict attention of each subject to the tasks required by the test.

The decrease in the mean performance of the experimental group can be attributed to the conditioning procedures. There are a number of reasons for this. First of all, an examination of the answer sheets of the subjects in the experimental group shows that the responses under the column heading, Shading of Figures for the items where shading was relevant, show an inordinately high frequency of error in comparison to the other column. There is no evidence of this in the answer sheets of the control group. In most cases subjects simply placed an X indicating that, according to their identification of the concept, black was not relevant. In many instances subjects not only missed the attribute of shading but also the kind of figure when a particular kind of figure was relevant. This is especially remarkable because the concepts were not relational; that is, a particular kind of figure was never associated with a particular kind of shading. In fact, this was deliberately avoided in the construction of the test and was mentioned when introducing it to the subjects.

The statistical results also support the above conclusion regarding the effectiveness of the conditioning. The analyses of variance showed that the differences between the experimental and control groups was most marked on the items where black was relevant. An actual count of the number of correct responses under the column, Shading of Figures,

was not undertaken because, as mentioned previously, the conditioning effects tended to transfer to the information required by the other columns with the exception of the column, Number of Borders.

It is clear then that the experiences of the experimental subjects on the form discrimination test resulted in conditioned avoidance of the color black which carried over or was transferred to the Concept Attainment Test. These conclusions are in agreement with the findings of Walters (1959), Solley and Murphy (1960) and Olsen and Harper (1963). The conditioned avoidance took the form of a negative cue affect so that subjects tended to avoid or omit the shaded figures or to forget that they had seen them when deciding what the relevant attributes of the concepts in the problems were.

The semantic differentials present fairly unequivocal evidence that the Form Discrimination Test did in fact establish an avoidance response. The results on the differentials concur with the findings of Staats, Staats, and Briggs (1958) who used a similar differential to measure a shift in the connotative meaning of color names as a result of associative conditioning. In the present experiment, it might be argued that the difficulty of the Concept Attainment Test itself had this effect since it contained black figures and lines. If this were so, the control group would have shown much the same trend as the experimental group on the differentials.

It may be concluded then that the score differences between the experimental and control groups are significant and are a result of the conditioning procedures. The reduction of the scores of the experimental group can then be considered as a measure of conditiona-

bility. From this it follows that the subgroups of the experimental and control groups can further be compared to see whether extraversion and introversion are related to conditioning or whether sex differences exist.

The results of the experiment provide no evidence of either relationship. These findings are similar to those of Becker and Matheson (1961), Lovibond (1963) and Rechtschaffen (1958). They are not in agreement with those of Eysenck (1959b).

From the results of the experiment, it is difficult to state whether the experimental subjects simply did not perceive the shaded figures or whether they perceived them but did not take their perceptions into account when deciding which attributes were relevant to a given concept and which were not relevant. In the former case it would be a matter of selectivity in perception which could be explained in terms of a gating process or in terms of stimuli which were not attended to in the performance of a complex task. In the latter case it would be a matter of motivated forgetting or repression.

The results of the semantic differentials indicate that the negative affect value attached to the concept black by the conditioning procedures transferred even beyond the perception of shaded figures and the cognitive processes connected with them. The connotative meaning of the concept itself, presented in a verbal form, and in a completely different context, was slightly modified for the duration of the experiment. It can be concluded from this that affective conditioning generalizes readily and is therefore effective in altering the cognitive functions of the individual in a variety of contexts which are only fundamentally related to the original conditions under whidh the conditioning occurred.

The ratings on the semantic differential could possibly have been averaged assuming that the pleasant - unpleasant, beautiful - ugly and happy - sad scales are all evaluative in a broad sense. The data indicate however that these scales are nearly all independent with the exception of the correlation between the good - bad and pleasant - unpleasant scales. This relationship is in agreement with Osgood, Suci and Tannenbaum (1956 pp.37-43) who found that the pleasant - unpleasant scale loads very highly on the evaluative dimension, that is, on the dimension measured by the good - bad scale. The stable negative rating for the concept black on the happy - sad scale on the part of both the experimental and control groups reflects a well known cultural value.

Although the experiment was not originally designed to test the relationship of neuroticism to conditionability, the data available gave no suggestion of a simple relationship. It may well be that a complex relationship exists particularly when variables such as stress are introduced (D'Aoust, 1964).

The absence of a significant correlation between the concept attainment scores and the A.C.E. scores of the subjects indicates a fundamental difference in the nature of the abilities measured by each. The Concept Attainment Test requires a rapid perception of a relatively large amount of simple information and the capacity to perceive regularities in this information. The individual must generate hypotheses almost intuitively and test a number of these in very rapid succession. A high degree of adaptive flexibility is required when the hypothesis which the individual tentatively advances must be rejected in the light of further evidence. This also requires divergent thinking. Finally the concept attainment test contains a factor of immediate memory. The

individual must retain a vast array of detail over a short period of time.

The A.C.E. Test on the other hand is more a measure of what the individual has learned in terms of language and number skills. Many of the problems are not unlike those encountered by the student in elementary and secondary school. There is no immediate memory factor because the individual can always reread the question and go over the information given. This is not possible on the Concept Attainment Test. On the A.C.E. Test, many of the items, particularly those of the vocabulary subtest, are a simple matter of knowledge; the subject either does or does not know. On the Concept Attainment Test, specific learnings of this naturedo not give the individual an appreciable advantage.

II CONCLUSIONS

From the analysis and interpretation of the experimental data, it may be concluded that the experimental hypotheses derived from Major Hypothesis I, Chapter IV, are tenable. Negative conditioning functions in the manner predicted by the first hypothesis. Differences in performance predicted by the second hypothesis were shown to exist between the experimental and control groups; the magnitude of these differences on the various items of the task supported the third hypothesis. The experimental hypothesis derived from Major Hypothesis II is not supported. The experimental data showed no significant differences in the directions predicted. It may be concluded then, that in a situation involving operant verbal conditioning, there are no significant differences between extraverts and introverts in terms of the readiness or ease with which they will condition.

Since the dimension of extraversion is not relevant to conditioning, sociability and impulsiveness, the second order factors of extraversion are not relevant as well. It was evident from the sampling data that the extraverts were significantly more sociable and more impulsive than the introverts.

Limitations

The foregoing conclusions are subject to a number of limitations. First of all, they are valid only insofar as the sample selected was representative of a college freshman population. Secondly, these conclusions apply only to the extent that the M.P.I. is an adequate measure of extraversion and introversion. It may well be that differences exist but that the individuals selected by this scale did not possess these traits to the extent indicated by their scores. Moreover, the conclusions apply only to operant verbal conditioning. The differences in conditionability which Eysenck's theory and related research indicate, may well exist for classical conditioning but do not appear to have any relevance to operant verbal conditioning. The absence of significant interactions lends further support to the conclusions that the personality variables investigated in this study bear no systematic relationship to conditionability in a situation of operant verbal conditioning.

CHAPTER VIII

THE EXPERIMENT PART IV
IMPLICATIONS FOR THEORY, RESEARCH AND EDUCATION

The present chapter concludes the series on the experiment. It presents the implications of the study for psychological theory, for further research and for educational practice.

Theoretical Implications

The results of the experiment indicate that the close relationship between perception and cognition which is fundamental to theories such as those of Allport (1955) and Bruner (1957) appears to exist at least in terms of the behaviour observed. Bruner's theory of perception as categorization with its concomitant mediational functions, particularly that of a gating function, is an adequate model for the behavior observed in the experiment. The problem solving behavior of the subjects suggested that the cognitive functions involved in concept attainment can be described as a search for relevant attributes.

The results and conclusions might also be considered in the light of the social aspects of the experiment. Orne (1962) drew attention to the psychological experiment as a special type of social situation in which the subject essentially places himself under the control of the experimenter and co-operates with him. The motivation of the individual then is important both in terms of how the subject perceives the experiment and how he performs on the required tasks. The results therefore imply a close relationship between motivation, perception, and cognition.

The aspects of Eysenck's theory considered in this study were not supported by the experimental results. There does not appear to be a simple relationship between the extraversion-introversion dimensions and conditionability. There is some indication that the dimensions of extraversion and introversion are very complex traits which are perhaps not as distinct or as mutually exclusive as many theories describe them to be. Generally the results suggest that the principle of an excitation-inhibition balance requires more refinement before it can be considered as a foundation for a scientific theory of personality.

Although learning theory is only incidental in the present study, the results of the operant conditioning procedures support the widely held conception of one form of learning as the modification of behavior through the selective reinforcement of operants. The observations of the experiment indicate that the paradigm and basic principles of operant conditioning apply not only to overt actions but also to implicit verbal behavior or thoughts.

Implications for Further Research

The effects of cue avoidance conditioning upon concept attainment demonstrated in this study suggest a number of research problems in the area of perception and cognition. Further research is required to identify various kinds of cue avoidance and to establish their dominance in a response hierarchy. The question of what forms transfer most readily and the extent to which they transfer in different situations should also be investigated.

The area of concept attainment itself is one which has many unknowns. The low correlation between the concept attainment scores and

the A.C.E. scores obtained in this study indicates a need for research to identify the mental abilities involved in concept attainment tasks. The group administration of the Concept Attainment Test suggested that there are individual differences in the capacities for learning the strategies involved. This might be investigated further, particularly in relation to variables connected with the complexity of the concepts. Furthermore, the answer sheets of the Concept Attainment Test indicated that average subjects, after having reached a learning criterion, had difficulty in handling more than three relevant attributes at the same time. There is some reason to believe that the average cognitive capacity is limited to three attributes when the time limits and the complexity of each item are similar to those used in the present experiment. This as well as other variables such as the number of positive and negative exemplars given, the amount of redundant information which they contain and the number of alternatives of each attribute merit further investigation.

In personality, the search for variables which are related in a systematic way to conditioning, particularly to operant verbal conditioning, needs to be intensified. In conditioning itself, the question of similarities and differences between operant and verbal conditioning presents many hypotheses which are still untested.

Educational Implications

One of the important educational implications of the study is that learning to avoid cues relevant to the material learned can be detrimental to cognitive functioning. Teachers know intuitively that a classroom atmosphere or a teaching method should not foster aversive reactions to the subject material on the part of the students. This

experiment has demonstrated in detail some of the consequences of such a response. It is not sufficient to say that if students do not like a subject or something associated with it, they will have difficulty in learning it. It is of theoretical and practical interest to note why this is so and to identify some of the behavioral mechanisms involved in this learning incapacity. It then becomes possible to say what some of the causal factors are which underlie a general lack of motivation and interest. Thompson and Hunnicutt (1944) have shown that extraversion and introversion as personality dimensions are related to the motivational effects of praise and blame. The nature of this relationship might further be investigated by means of verbal conditioning.

Finally, the experiment has demonstrated that negative experiences can and do transfer readily. Like other forms of learning, they frequently do not apply only to the context within which they have been learned. This is particularly important when transfer takes the form of unconscious generalization.

In conclusion, this dissertation bears evidence of the challenge which still lies ahead in the study of cognitive behavior. There are as yet many variables which are unknown and many which are only dimly discernible. A better understanding of these will provide important foundations for the improvement of educational theory and practice.

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APPENDICES

APPENDIX A. TESTS AND SCALES USED

SOCIABILITY - IMPULSIVENESS SCALE

The following is a copy of the sociability-impulsiveness scale used in sample selection.

Name ____________________

Age ____________________

Questionnaire

Instructions:

Here are some questions regarding the way you behave, feel and act. After each question there is a "Yes" a "?" and a "No".

Try and decide whether "yes" or "no" represents your usual way of acting or feeling then put a circle round the "Yes" or "No". If you find it impossible to decide put a circle round the "?", but do not use this answer except very occasionally, Work quickly, and don't spend too much time over any question; we want your first reaction, not a long drawn-out process! The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions.

1. Are you reserved and distant except to intimate friends? Yes ? No
2. Do you like to mix socially with people? Yes ? No
3. Is your motto to take matters of everyday life with proper seriousness rather than 'laugh and be merry'? Yes ? No
4. Do you enjoy opportunities for conversation so that you rarely miss a chance for talking to a stranger? Yes ? No
5. Do you feel it essential to plan ahead carefully before beginning any undertaking? Yes ? No
6. Do you tend towards overcautious pessimism? Yes ? No
7. Would you rate yourself as a happy-go-lucky individual? Yes ? No
8. Are you ordinarily a carefree individual? Yes ? No
9. Are you inclined to keep in the background on social occasions? Yes ? No
10. In a group, do you hate having to introduce people to each other? Yes ? No
11. Are you inclined to be shy in the presence of the opposite sex? Yes ? No
12. When people shout at you, do you shout back? Yes ? No
13. If you want to learn about something, would you rather do it by reading a book on the subject than by discussion? Yes ? No

14. Do you tend towards a rather reckless optimism? Yes ? No

15. Do you often crave excitement? Yes ? No

16. Are you inclined to keep quiet when out in a social group? Yes ? No

17. Would you be very unhappy if you were prevented from making social contacts? Yes ? No

18. Does your natural reserve generally stand in your way when you want to start a conversation with an attractive stranger of the opposite sex? Yes ? No
Yes ? No

19. Would you rather spend an evening by yourself than go to a dull party? Yes ? No

20. Can you usually let yourself go and have a hilariously good time at a gay party? Yes ? No

21. Do you usually take the initiative in making new friends? Yes ? No

22. Are you inclined to stop and think things over before acting? Yes ? No

23. Are you a person who is not much given to cracking jokes and telling stories to your friends? Yes ? No

24. Can you readily get some life into a rather dull party? Yes ? No

25. Do other people regard you as a lively individual? Yes ? No

26. Do you prefer action to planning for action? Yes ? No

27. Would you describe yourself as an easy going person not concerned to be precise? Yes ? No

28. Is it difficult to 'lose yourself' even at a lively party? Yes ? No

29. On the whole do you prefer the company of books to people? Yes ? No

30. Are you inclined to limit your acquaintances to a select few? Yes ? No

31. Would you rate yourself as an impulsive individual? Yes ? No

32. Do you tend to be slow and deliberate in movement? Yes ? No

33. Would you do almost anything for a dare? Yes ? No

34. Are you happiest when you get involved in some project that calls for rapid action? Yes ? No

35. Do you often act on the spur of the moment without stopping to think? Yes ? No

36. Do you like to have many social engagements? Yes ? No

37. Are you given to acting on impulses of the moment which later land you in difficulties? Yes ? No

SEMANTIC DIFFERENTIAL

The following is a copy of the semantic differential used in the experiment.

Name _____________________

COLOR RATING QUESTIONNAIRE

The purpose of this study is to measure the meanings of certain colors to various people by having them rate them on a descriptive scale. Please make your judgments on the basis of what these colors mean to you. On the following pages you will find four colors to be rated. Under each color are 10 scales. Here is how you are to use these scales:

If you feel that the color at the top of the page is very closely related to one end of the scale, you should place your check mark as follows:

Fair __X__ : _____ : _____ : _____ : _____ : _____ : _____ Unfair
or
Fair _____ : _____ : _____ : _____ : _____ : _____ : __X__ Unfair

If you feel that the color is quite closely related to one or the other end of the scale, you should place your check mark as follows:

Strong _____ : __X__ : _____ : _____ : _____ : _____ : _____ Weak
or
Strong _____ : _____ : _____ : _____ : _____ : __X__ : _____ Weak

If the color is only slightly related to one side as opposed to the other, then check as follows:

Beautiful _____ : _____ : __X__ : _____ : _____ : _____ : _____ Ugly
or
Beautiful _____ : _____ : _____ : _____ : __X__ : _____ : _____ Ugly

Finally, if you consider the color to be neutral on the scale and completely irrelevant, place your mark in the centre space as follows:

Soft _____ : _____ : _____ : __X__ : _____ : _____ : _____ Hard

Make each item a separate and independent judgment and work quickly. Do not worry or puzzle over individual items. It is your first impression or immediate feeling that is required. Please do not be careless and give your true impression.

WHITE

Pleasant _____ : _____ : _____ : _____ : _____ : _____ : _____ Unpleasant

Ugly _____ : _____ : _____ : _____ : _____ : _____ : _____ Beautiful

Soft _____ : _____ : _____ : _____ : _____ : _____ : _____ Hard

Dangerous _____ : _____ : _____ : _____ : _____ : _____ : _____ Safe

Strong _____ : _____ : _____ : _____ : _____ : _____ : _____ Weak

Important _____ : _____ : _____ : _____ : _____ : _____ : _____ Trivial

Passive _____ : _____ : _____ : _____ : _____ : _____ : _____ Active

Happy _____ : _____ : _____ : _____ : _____ : _____ : _____ Sad

Unfair _____ : _____ : _____ : _____ : _____ : _____ : _____ Fair

Good _____ : _____ : _____ : _____ : _____ : _____ : _____ Bad

BLACK

Pleasant _____ : _____ : _____ : _____ : _____ : _____ : _____ Unpleasant

Ugly _____ : _____ : _____ : _____ : _____ : _____ : _____ Beautiful

Soft _____ : _____ : _____ : _____ : _____ : _____ : _____ Hard

Dangerous _____ : _____ : _____ : _____ : _____ : _____ : _____ Safe

Strong _____ : _____ : _____ : _____ : _____ : _____ : _____ Weak

Important _____ : _____ : _____ : _____ : _____ : _____ : _____ Trivial

Passive _____ : _____ : _____ : _____ : _____ : _____ : _____ Active

Happy _____ : _____ : _____ : _____ : _____ : _____ : _____ Sad

Unfair _____ : _____ : _____ : _____ : _____ : _____ : _____ Fair

Good _____ : _____ : _____ : _____ : _____ : _____ : _____ Bad

DARK

Pleasant _____ : _____ : _____ : _____ : _____ : _____ : _____ Unpleasant

Ugly _____ : _____ : _____ : _____ : _____ : _____ : _____ Beautiful

Soft _____ : _____ : _____ : _____ : _____ : _____ : _____ Hard

Dangerous _____ : _____ : _____ : _____ : _____ : _____ : _____ Safe

Strong _____ : _____ : _____ : _____ : _____ : _____ : _____ Weak

Important _____ : _____ : _____ : _____ : _____ : _____ : _____ Trivial

Passive _____ : _____ : _____ : _____ : _____ : _____ : _____ Active

Happy _____ : _____ : _____ : _____ : _____ : _____ : _____ Sad

Unfair _____ : _____ : _____ : _____ : _____ : _____ : _____ Fair

Good _____ : _____ : _____ : _____ : _____ : _____ : _____ Bad

GREEN

Pleasant _____ : _____ : _____ : _____ : _____ : _____ : _____ Unpleasant

Ugly _____ : _____ : _____ : _____ : _____ : _____ : _____ Beautiful

Soft _____ : _____ : _____ : _____ : _____ : _____ : _____ Hard

Dangerous _____ : _____ : _____ : _____ : _____ : _____ : _____ Safe

Strong _____ : _____ : _____ : _____ : _____ : _____ : _____ Weak

Important _____ : _____ : _____ : _____ : _____ : _____ : _____ Trivial

Passive _____ : _____ : _____ : _____ : _____ : _____ : _____ Active

Happy _____ : _____ : _____ : _____ : _____ : _____ : _____ Sad

Unfair _____ : _____ : _____ : _____ : _____ : _____ : _____ Fair

Good _____ : _____ : _____ : _____ : _____ : _____ : _____ Bad

CONCEPT ATTAINMENT TEST FORM

The following is a copy of the concept attainment test blank with the correct answers to all items filled in.

CONCEPT ATTAINMENT RESEARCH

Name .... Section ....

Fill in your answers for each problem in the spaces indicated. Remember that a complete answer to a problem may consist of any number of parts from one to four. Place an X in the appropriate space whenever a heading does not apply to the problem; that is, whenever the attribute is not relevant to the concept.

Problem Number	Total Number of Figures	Kind of Figures	Shading of Figures	Number of Borders
Practice A	X	Circle Square	X	1
Practice B	3	Circle Triangle Square	Striped	X
I	2	X	Striped	X
II	X	Triangle	X	2
III	2	X	X	1
IV	X	Circle	Shaded	1
V	X	Square Triangle	X	No Border
VI	X	Triangle	Striped	X
VII	X	Circle Triangle	Shaded	No Border
VIII	3	Circle	White	2
IX	X	Square	Shaded	2
X	X	Circle	Shaded	No Border

APPENDIX B INSTRUCTIONS USED WITH THE TESTS AND SCALES

I INSTRUCTIONS GIVEN TO THE SUBJECTS BEFORE TAKING THE CONCEPT ATTAINMENT TEST IN THE SAMPLING PROCEDURE
(GROUP ADMINISTRATION)

(Examiner passes out answer sheets before beginning)

"Please fill in your name and section number in the spaces provided. As you can see by the title of the sheet, we are going to do some work on concept attainment. Before explaining what this involves, I want to assure you that this is in no way a disguised test. The results will be confidential and will be used for research purposes only. I hope you will find this a learning experience and that you will enjoy participating.

Briefly this is a study on deductive and inferential reasoning. The purpose is to find out more on how people acquire information and how they use it to come to conclusions. In order to do this, I have prepared a series of problems involving simple figures."

(Examiner displays the sample set of cards on the blackboard ledge) As you can see there are three possibilities regarding the number of figures on each card. We can have cards with one figure, two figures or three figures."

(Examiner writes the following on the board:)

Number
one
two
three

Next there are three possibilities regarding the kind of figures. We can have a square, a circle or a triangle. (Examiner writes the key words on the board as indicated above)

The next possibility is the variation in shading. The figures may be

white, striped, or shaded. (Examiner again writes the key words on the board) The last possibility, as you probably have noticed by now, is the variation in borders. Cards may have no border, one border, or two borders. (Examiner writes key words on the board as before) In summary, each card represents four possible dimensions: Number, kind, and shading of figures and number of borders. These are the only variable to which you will have to attend." (Examiner repeats the dimensions for emphasis.)

"What then, is a concept? Let me give you an example of the sort of thing we are after. I have a concept in mind. I shall give you an example which will be either positive or negative. See if you can guess what it is." (Examiner writes the following on the board:)

automobile
bus
apple
bicycle
ship
airplane
locomotive
sled

"What is the concept? Yes. Wheeled conveyances. You noticed that the negative examples did not contain all of the attributes of the concept. Note that as I presented you with each successive example or non-example, you used the information to develop an hypothesis or guess about my concept and then refined or narrowed down the possibilities. In a similar way, the concepts we will work with are going to be a combination of attributes. I will show you six cards in succession and tell you whether the card is positive or negative and your task will be to sort this information out and then fill in the concept on your sheet. For example, I might select a concept such as two figures

and one border. I will show you six cards in a given order and tell you whether each card contains or does not contain the concept I have in mind. At the end of each series, you will fill in your conclusions under the appropriate headings giving the details in each case. Here are six cards in which 2 figures and one border are the concept. (Examiner shows them in succession stating which is and which is not an example)

"Now just to be sure that you know what is involved and to give you some practice, we will do two practice problems. Be sure you fill in your answers as required in the appropriate spaces."

(Examiner administers the practice problems and then answers all further questions before proceeding with the main series)

II INSTRUCTIONS GIVEN TO THE SUBJECTS BEFORE TAKING THE CONCEPT ATTAINMENT TEST IN THE EXPERIMENTAL PROCEDURE.

"We will now do the concept formation test which we did in class last term. (Examiner passes a test blank to the subject) Please fill in your name and section number and read the instructions in order to refresh your memory on what the test consisted of. (Examiner pauses) You probably remember that the test consists of figures on a series of cards. As you can see by the four columns before you, these figures can vary in four ways. First they can vary in terms of the number of figures which they contain. They may have either one, or two, or three figures. (Examiner shows an appropriate sample card each time.) Next they can vary in terms of the kind of figure. The cards may have either a triangle, a circle, or a square or any combination of each. Next they can vary in terms of shading of the figures. They may be either clear, striped, or shaded. The variations will always be as indicated here; that is, the white and stripes and the shading will always be exactly as the samples just shown. Lastly the cards can vary according to the number of borders. There may be no border at all, one border, or two borders. In review then, the problems will be made up from a set of cards which have four major attributes with three possible variations under each. Number of figures; one, two, or three, kind of figures; circle, triangle, or square; shading of figures: clear striped, or shaded and number of borders, one, two, or three.

Now what is a concept and how are you to identify it? We will identify a concept as a particular combination of some of the attributes we have just reviewed. Just as we might define a concrete object

such as pencil in terms of a number of characteristics such as long, slender, fits into the hand, and has a writing edge, we will define a concept here in terms of such things as a circle and a square with one border. Note that the number of figures or their shading is not relevant here. Just as color is not relevant to pencil. (Examiner shows three pencils of different colors) Let me show you a set of examples by which you might define the concept of circle and a square with one border. Now that you know the answer, you can study the structure of the problem. Here is the first card. (Examiner shows a positive example) This is one as you can see. It may contain additional information but it has the characteristics essential to the concept. (Examiner shows the remaining positive and negative examples explaining each in turn) Now let us pretend that neither of us knows what the concept is and we are faced with the task of identifying it from the positive and negative examples given by the six cards. (Examiner goes through the cards again and gives examples of the logic involved) Here are two practice problems which we will do before beginning the main series. This is to insure that you are familiar with the task. As before, I will show you six cards and tell you whether or not each card represents the concept I have in mind. Study each card carefully and when you have seen the last card of each problem, fill in the answer on the sheet before you. Whenever an attribute such as number of figures on the card is not relevant, simply fill in an X as indicated. (Examiner gives practice problems A and B and discusses any questions which might arise) Now before beginning the main series there are two suggestion I should make. Be sure that you dis-

tinguish carefully between 0 and X under the heading Number of Borders. 0 means that no border is part of the concept; that is the border must be absent. X means that any number of borders including zero will do since borders are not relevant to the concept. Next, you need not pay attention to the relationship between the attributes. You might be led to believe that 2 figures require 2 borders, or that it is always the square which is shaded or that 2 triangles rather than any two figures are relevant to a given concept. (Examiner shows examples of these) These are relational concepts because the attributes are related. The test was specially constructed to avoid this type of concept. It contains only conjunctive concepts which means that all the defining attributes must be present but that they are not necessarily related." (Examiner answers any further questions and then gives the main series) "We will now do the main series. Here is the first card. This is one." (Examiner says "This is one," when showing a positive example and "This is not one," when showing a negative example.

III. INSTRUCTIONS GIVEN TO THE EXPERIMENTAL GROUP BEFORE TAKING THE FORM DISCRIMINATION TEST

"We will now do a test of form discrimination. I am interested in individual differences in perception. The test is arranged in the form of multiple choice items. I will show you a sample card which will contain a given form. Look carefully at this and memorize the details of its shape. I will then show you a large sheet which has four cards like this mounted on it. The forms on these cards will be to select the one out of these four which is most similar to or most resembles the sample form." (Examiner shows the subject the sample card for approximately ten seconds.) Look carefully at this form. (Examiner replaces the sample card in the folder and holds up the test sheet.) "Select the one which most resembles the sample. You can see that you have four possible answers: _Upper right_, _upper left_, _lower right_, _lower left_. Which is the correct one here?"

"In order that you may concentrate fully on the items, I shall take down your answers and keep the score for you. I will tell you after each item whether you were right or wrong. Here is the first item. (Examiner says "Sample" as he holds up the sample card and "Test" as he holds up the test sheet.)

APPENDIX C

SAMPLING AND EXPERIMENTAL DATA

I SAMPLING DATA
EXPERIMENTAL GROUP

	EXTRAVERTS					INTROVERTS				
	Sub.No.	Ext.	Soc.	Imp.	Con.A.	Sub.No.	Ext.	Soc.	Imp.	Con.A.
FEMALES	1	35	19	5	29	21	16	7	6	23
	2	40	16	9	32	22	21	7	6	32
	3	33	11	15	23	23	10	4	4	17
	4	37	12	4	34	24	13	6	6	18
	5	37	14	16	27	25	22	11	8	23
	6	32	17	9	24	26	19	7	6	38
	7	32	14	4	23	27	20	4	9	23
	8	36	10	10	26	28	8	7	5	26
	9	40	17	13	25	29	13	8	2	21
	10	42	17	10	34	30	14	3	2	24
MALES	11	36	17	5	34	31	22	11	10	30
	12	41	17	11	26	32	22	5	7	25
	13	32	16	3	16	33	14	8	8	30
	14	38	16	8	24	34	22	5	9	35
	15	33	12	10	30	35	21	9	12	27
	16	36	15	10	23	36	19	2	2	27
	17	38	18	4	30	37	10	1	8	31
	18	38	19	5	25	38	17	4	13	18
	19	34	14	10	29	39	20	5	7	33
	20	39	15	13	20	40	11	6	5	21

Sub. No. - Subject number., Soc. - Sociability Score.,
Imp. - Impulsivity Score., Ext. - Extraversion-Intorversion Score.,
Con. A. - Concept Attainment score on group test.

SAMPLING DATA
CONTROL GROUP

	EXTRAVERTS					INTROVERTS				
	Sub.No.	Ext.	Soc.	Imp.	Con.A.	Sub.No.	Ext.	Soc.	Imp.	Con.A.
FEMALES	43	43	17	8	20	61	10	6	2	19
	42	39	16	8	33	62	19	7	5	35
	43	33	15	11	26	63	16	6	2	31
	44	38	18	6	32	64	22	9	9	23
	45	41	14	7	28	65	12	2	11	31
	46	39	19	10	27	66	20	13	4	26
	47	36	17	11	12	67	14	8	5	35
	48	34	15	11	24	68	20	7	2	15
	49	39	17	7	27	69	20	10	3	32
	50	38	16	10	34	70	14	4	7	30
MALES	51	31	18	16	25	71	12	9	6	21
	52	38	19	13	26	72	16	2	5	21
	53	33	13	8	21	73	8	4	1	20
	54	41	18	12	18	74	22	8	4	27
	55	39	12	9	37	75	7	0	4	30
	56	36	13	13	26	76	10	4	3	29
	57	33	12	8	30	77	18	7	2	16
	58	32	15	6	20	78	20	5	3	23
	59	36	11	13	18	79	21	12	4	33
	60	36	19	7	31	80	13	2	3	18

Sub.No. - Subject Number, Soc. - Sociability Score,
Imp. - Impulsivity Score, Ext. - Extraversion-Introversion Score
Con.A. - Concept Attainment Score on group test

II EXPERIMENTAL DATA
CONCEPT ATTAINMENT SCORES OF THE EXPERIMENTAL GROUP

	EXTRAVERTS				INTROVERTS			
	Sub.No.	Con.A_T	Con.A_1	Con.A_2	Sub.No.	Con.A_T	Con.A_1	Con.A_2
	1	20	6	14	21	21	6	15
	2	31	15	16	22	31	9	22
	3	20	8	12	23	21	8	13
	4	30	11	19	24	19	3	16
MALES	5	28	10	18	25	18	5	13
	6	20	4	16	26	36	14	22
	7	23	9	14	27	25	11	14
	8	27	10	17	28	25	7	18
	9	19	5	14	29	19	8	11
	10	29	11	18	30	20	4	16
	11	29	10	19	31	27	12	15
	12	24	7	17	32	26	10	16
	13	17	7	10	33	27	8	19
	14	19	7	12	34	25	6	19
LES	15	27	10	17	35	25	6	19
	16	17	7	10	36	27	10	17
	17	30	11	19	37	24	7	17
	18	28	9	19	38	17	4	13
	19	31	11	20	39	27	11	16
	20	19	7	12	40	14	4	10

Sub. No. - Subject Number, Con A_T - Concept attainment test, total score
Con. A_1 - Concept attainment test score on the four items where black was relevant
Con. A_2 - Concept attainment test score on the six items where black was irrelevant

EXPERIMENTAL DATA
CONCEPT ATTAINMENT SCORES OF THE CONTROL GROUP

	EXTRAVERTS				INTROVERTS			
	Sub.No.	Con.A_T	Con.A_1	Con.A_2	Sub.No.	Con.A_T	Con.A_1	Con.A_2
	41	28	8	20	61	26	10	16
	42	36	14	22	62	30	10	20
	43	26	11	15	63	30	10	20
	44	34	13	21	64	28	7	21
EMALES	45	30	11	19	65	31	12	19
	46	34	13	21	66	24	7	17
	47	22	9	13	67	34	12	22
	48	23	9	14	68	20	7	13
	49	35	13	22	69	33	12	21
	50	33	15	18	70	31	13	18
	51	24	11	13	71	24	8	16
	52	26	9	17	72	24	8	16
	53	29	9	20	73	25	8	17
	54	23	10	13	74	30	10	20
LES	55	30	12	18	75	29	11	18
	56	26	8	18	76	34	12	22
	57	23	9	14	77	22	7	15
	58	18	7	11	78	28	11	17
	59	26	12	14	79	31	11	20
	60	30	12	18	80	26	9	17

Sub.No. - Subject Number. Con.A_T - Concept Attainment Test: Total Score
Con.A_1 - Concept Attainment Test score on the four items where black was relevant
Con.A_2 - Concept Attainment Test score on the six items where black was irrelevant

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